SE7 Sensors On The Move

Organizer: Kofi A.A. Makinwa, Delft University of Technology, Delft, The Netherlands
Chair: Herman Casier, AMI Semiconductor, Oudenaarde, Belgium

The aim of this session is to highlight new and exciting developments in the field of automotive sensors. Today, a typical light vehicle will employ more than 20 sensors, ranging in complexity from simple position sensors to MEMS accelerometers. Broadly speaking, these sensors are used to enhance engine and power-train performance and reliability, ensure compliance with various environmental standards, and increase occupant comfort and safety. Due to the constant demand for vehicles with increased performance, lower environmental impact and greater levels of comfort and safety, it is certain that more sensors will be used in the vehicles of tomorrow. The sensors discussed in this session: tire pressure sensors, thermoelectric infrared imaging sensors, oil condition sensors and MEMS gyroscopes, are all examples of sensors that are about to find widespread use in automotive applications.

Position Statements

Tire Pressure Monitoring Systems
Ir. Jakob Jongsma, Infineon, Graz, Austria
The 2000 TREAD act forced US car makers to provide car owners with information about appropriate tire inflation levels and load limits. Initial systems were based on the relative rotation speed of the wheels obtained from the anti-blocking system (ABS) sensors. The limited accuracy and long latency in these systems prompted OEMs to look at more advanced methods. In this presentation, we will discuss the development of a tire pressure monitoring system (TPMS), which consists of MEMS sensors for measuring pressure and acceleration, sensor interface circuitry, and a radio frequency communication link. Since safety and reliability in the harsh automotive environment are paramount customer concerns, these issues will be addressed as well. The presentation will be rounded off with a look at future systems.

Thermoelectric Infrared Imaging Sensors

Masaki Hirota, Nissan Motor Co., Ltd., Kanagawa, Japan

Un-cooled infrared imaging sensors are promising devices for the detection of human beings in automotive applications. Such sensors can be used, for instance, to realize systems for human body detection and climate control. At present, however, the price of infrared imaging sensors is rather high, and as such they have only been used in top-of-the-range vehicles. In order to promote their widespread use, further cost reductions are necessary. Using a CMOS process and micromachining technology, we have developed a high responsivity thermoelectric infrared sensor consisting of a 120 x 90 element array with low-cost potential. Each element consists of poly-silicon thermocouples mounted beneath a precisely patterned Au-black infrared absorber. This presentation will discuss the sensor, its readout electronics and its application in human body detection and climate control systems. The paper will also give an overview of the current state-of-the-art in infrared sensors and their use in automotive applications.

Oil Condition Sensors

Bernhard Jakoby, Johannes Kepler University, Linz, Austria

Monitoring the condition of engine oil is of great interest in automotive applications. Since the recommended intervals between oil changes are based on worst-case assumptions, they can be increased by actually monitoring oil condition. Moreover, such monitoring provides extra information about the state of the engine, thereby enhancing the detection and diagnosis of potential problems. In the quest for a robust low-cost sensor, several sensors, each probing different aspects of oil condition, have been evaluated. In particular, we have investigated permittivity, temperature, and viscosity sensors. In our presentation, we review the general demands on oil condition sensors and current developments on the market, outline the relevance of the selected parameters and the interpretation of the measured signals, discuss the development of a miniaturized micro-acoustic viscosity sensor and the associated readout electronics, and finally provide some sample results illustrating the application of the sensor.

Inertial Sensors for Automotive Applications

Bill Clark, Analog Devices, Cambridge, MA

Several significant advances in automotive safety have been enabled by MEMS. Airbag systems, in particular, are well established. They rely on a combination of inertial sensing and signal processing to distinguish crashes and rollovers from more mundane events. More recently, various stability control systems which use MEMS accelerometers and gyroscopes have matured. The vehicles in which they are deployed have a much reduced tendency to crash. The key to the widespread use of such sensors is a combination of exceptional reliability and very low cost. Both of these requirements have been achieved by the complete integration of micromachined sensors with the associated readout electronics. However, recent demands for such sensors to incorporate a variety of digital filters and interfaces have renewed interest in a multi-chip approach. This talk will outline various means of addressing these requirements in the design and mass production of commercial products.